P2000,0009 US

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I claim:

1.     A method for monitoring an analog meter having a set of graduation segments and at least one needle, the method comprising the steps of:
- recording a digitized image of the meter;
- extracting a set of edge points, the points representing the graduation segments;
- performing a Hough Transform on the set of edge points so as to obtain a center point of the graduation segments; and
- extracting an intensity profile of the image along a path through the graduation segments so as to obtain a set of detected graduation segments and a position of the needle relative to the graduation segments.

2.     The method according to claim 1, further comprising the steps of:
- obtaining a parameter representative of needle position accuracy;
- recording a second digitized image of the meter;
- obtaining a position of the needle without performing a Hough Transform so as to obtain a position of a center point when the parameter meets a predefined condition; and
- performing the Hough Transform so as to obtain the center point when the parameter does not meet the predefined condition.

3.     The method according to claim 2, wherein a number of discreet contiguous angles are obtained for the parameter when an intensity profile is below a threshold intensity.

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4.   The method according to claim 1, wherein the step of
     performing a Hough Transform further comprises the steps
     of:

-    for a subset of graduation segments, obtaining a
     corresponding candidate segment orthogonal to an edge
     gradient, of an edge point of each of the graduation
     segments, whereby the candidate segment is located a
     predefined distance from the edge point of the
     graduation segments;

-    obtaining an extreme value of the distribution of the
     candidate segment of the subset;

-    obtaining a centroid of the extreme value.

5.   The method according to claim 1, further comprising the
     step of:

-    extracting at least one set of local minimum intensity
     values from the intensity profile by applying a deep
     pocket criterion and selecting a set of local extreme
     values comprising a number of the extreme values with a
     predefined range.

6.   The method according to claim 2, wherein the step of
     obtaining a position of the needle further comprises the
     steps of:

-    defining a range of radii each with respect to the
     center point;

-    obtaining at least one angle where the intensity of the
     image within the range of radii meets a predefined
     condition.

7.   The method according to claim 5, further comprising the
     step of:

-    obtaining at least two sets of local extreme values from
     the intensity profile at different radii, each

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radii with respect to the center point, and merging sets of local extreme values having similar angles.

8.   The method according to claim 1, further comprising the steps of:

-    obtaining a set of edge points in a predefined area surrounding the center point;

-    performing a Hough Transform on the set of edge points in a predefined area;

-    obtaining a pivot center of the needle; and

-    projecting the detected position of the needle to a plane of a graduation scale.

9.   The method according to claim 1, further comprising the step of:

-    comparing the positioning of the needle to the detected graduation segments so as to obtain a digital value for a display status of the meter;

-    comparing the digital value to a preset value; and

-    transmitting a message to a control station via a communication network.

10.  An apparatus for monitoring an analog meter, comprising:

-    a sensor for obtaining a digitized image;

-    a data processor for:

     -    extracting a set of edge points from the image wherein the edge points represent graduation segments of the meter,

     -    performing a Hough Transform on the set of edge points to obtain a center point,

     -    extracting an intensity profile of the image along a path through the graduation segments;

     -    obtaining a position of the needle relative to the set of detected graduation segments; and

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        an    interface    device    for    communicating    with    a
        communication    network    data    generated    by    the    data
        processor.